Tianshen He

Email: the53@wisc.edu **Tel:** +1 6084710577

Education

Fudan University Shanghai, China 09/2019-06/2023

Major: Physics; **Degree:** Bachelor of Science (June 2023)

University of Wisconsin-Madison Madison, WI, United States 09/2023-now

Master of Physics – Quantum Computing

Publications

- "Experimental Quantum Fast Hitting on Hexagonal Graphs", Hao Tang, Carlo Di Franco, Zi-Yu Shi, **Tian-Shen He**, Zhen Feng, Jun Gao, Ke Sun, Zhan-Ming Li, Zhi-Qiang Jiao, Tian-Yu Wang, M. S. Kim & Xian-Min Jin, *Nature Photonics*, 12, 754-758 (2018). website: https://www.nature.com/articles/s41566-018-0282-5
- "TensorFlow Solver for Quantum PageRank in Large-scale Networks", Hao Tang*, Ruoxi Shi*, **Tian-Shen He*** (co-first author), Yan-Yan Zhu, Tian-Yu Wang, Marcus Lee, Xian-Min Jin, *Science Bulletin*, 66,120-126 (2021). website: https://www.sciencedirect.com/science/article/pii/S2095927320305880
- "ScQ cloud Quantum Computation for Generating Greenberger-Horne-Zellinger States of Up to 10 Qubits", Chi-Tong Chen, Yun-Hao Shi, Zhong-Cheng Xiang, Zheng-An Wang, Tian-Ming Li, Hao-Yu Sun, **Tian-Shen He**, Xiao-Hui Song, Shi-Ping Zhao, Dongning Zheng, Kai Xu, Heng Fan, *Science China Physics, Mechanics & Astronomy.* website: https://doi.org/10.1007/s11433-022-1972-1
- "Simulating Photosynthetic Energy Transport on a Photonic Network", Hao Tang, Xiao-Wen Shang, Zi-Yu Shi, **Tian-Shen He**, Zhen Feng, Tian-Yu Wang, Ruo-Xi Shi, Hui-Ming Wang, Xi Tan, Xiao-Yun Xu, Yao Wang, Jun Gao, Myungshik Kim, *npj Quantum Information*, 10, 29 (2024).website:https://www.nature.com/articles/s41534-024-00824-x

Research & Projects

Member, Research on Many-body Localization using Fluxonium qubit 10/2023-now

Instructor: Prof. Roman Kuzmin, University of Wisconsin - Madison

- Based on the article about down conversion of down-conversion of a single photon as a probe of many-body localization, we are trying to promote measurement resolution by designing a new experiment protocol.

Member, Research on Topological Phase Transition of Toric Code Hamiltonian Based on Variational Quantum Circuit 09/2021-now

Instructor: Prof. Xiaopeng Li, Fudan University

- Studied the article about the quantum circuits for preparing the ground state of the toric code and recalculated the outcome in MindQuantum framework (Python).
- Figured out the problem of the original routine and the key points for the future research.
- Designed new circuits with Variational Quantum Eigensolver (VQE) to prepare the ground state of toric code in the case of an external magnetic field and considering ferromagnetic and antiferromagnetic Ising interaction.

Senior Community Developers, Huawei MindSpore Quantum Special Interest Group 06/2022-now

- Conducted the MindQuantum ecological promotion, feature development, demand collection, etc

Member, Cloud Quantum Computation for Generating Greenberger-Horne-Zellinger States of Up to 10 Qubits 07/2021-09/2022

Instructor: Prof. Heng Fan, Institute of Physics Chinese Academy of Sciences

- The main task is to design a quantum assembly language that fits the superconducting quantum computer hardware. To be more specific, the lab requires that in order to minimize noise, qubits adjacent to all two-qubit gates should be temporarily turned off.
- Learned IBM qiskit and how to realize quantum assembly language; implemented the syntax of IBM qiskit in our lab.
- Designed an algorithm based on topological sorting, and built it into my quantum assembly language qasmnew, which imitates the syntax of IBM qiskit, but automatically generates the shortest depth circuit while meeting the requirement.
- Published a paper in *Science China Physics, Mechanics & Astronomy*.

Researcher, The Efficient Solution to Heisenberg Model, Open Source Promotion Plan 07/2021

VQE Algorithm Based on MindQuantum to Solve Heisenberg Model (The most difficult topic)

Instructor: Dr. Xusheng Xu, Institute of Computing Technology, Chinese Academy of Sciences

- Read research papers and literature reviews about various previous methods of solving Heisenberg Model.
- Learned the MindQuantum framework by referring to the relevant documents and consulting Dr. Xu from Huawei.
- Programmed with the MindQuantum framework (Python) for the core solution; finished the diagonalizing Hamiltonian programming by MATLAB for analysis and verification of the results of MindQuantum VQE.
- Won the most valuable bonus of 12,000 RMB.

Leader, TensorFlow Solver for Quantum PageRank in Large-scale Networks 09/2018-01/2021

Instructor: Prof. Xianmin Jin, Prof. Hao Tang, Shanghai Jiao Tong University

- Sorted the Excel about civil aviation of the U.S. Dept. of transportation into an adjacency matrix.
- Abstracted the civil aviation system into a network, the airport into a website, and a flight a hyperlink; applied Google's PageRank algorithm to rank the importance of the website; calculated the ranking of the importance of each airport to the US civil aviation network; drew the civil aviation network diagram with Gephi.
- Obtained the quantum version of PageRank algorithm by replacing Google PageRank's random walk with quantum random walk; analyzed the advantages of the quantum version, and found the difficulty points.
- Developed a calculation package for solving quantum PageRank by TensorFlow parallel computing, and solved the quantum random walk matrix differential equation.
- Published a research article in *Science Bulletin* as a co-first author.

Member, Experimental Quantum Fast Hitting on Diagonal Graphs   **02/2017-10/2018**
Instructor: Prof. Xianmin Jin, Prof. Hao Tang, Shanghai Jiao Tong University
- Designed a new numbering method of the waveguide and calculated the Hamiltonian according to the honeycomb waveguide diagram in the experiment; simplified the adjacency relationship.
- Made predictions on the theoretical results of the experiment based on the Hamiltonian; programmed using MATLAB to calculate the quantum hitting in theory and classical hitting in theory for comparing the actual experimental results; drew and compared the theoretical and experimental results by MATLAB.
- Conducted the post-processing of experimental results, mainly the MATLAB processing of the images of the light intensity distribution map; designed the programming to identify the position of the light spot, and sum up the light intensity; compared the data with the incident light intensity and obtained the transmission rate.
- Concluded that the quantum walking algorithm can accelerate the fast-hitting problem; published the work on *Nature Photonics* and was awarded "2018 Top Ten Optical Developments in China".

Internships

Shanghai Jiao Tong University   **Shanghai**   **09/2022**
Research Assistance
- Helped Prof. Hao Tang to compile and design the structures of the textbook Quantum Computing Technology.
- Was responsible for four chapters: the initial formation of quantum mechanics, the principles for selecting physical systems, ion trap quantum computing, and quantum bits and quantum logic gates based on superconducting systems.

Institute of Physics, Chinese Academy of Sciences   **Beijing**   **08/2021**
Group Q03 Intern, Solid State Quantum Information and Computation Lab (full-time, 40 h/week)
- Mastered the physical principle of superconducting quantum computing; designed a set of quantum assembly language qasmnew with Python according to the requirements of the lab experiments.
- Learned the application of PHP, JavaScript, HTML languages to build web pages and realized the communication between front-end and back-end servers; built the superconducting quantum cloud platform scq.cloud (http://q.iphy.ac.cn/).

Activities & Awards

***Executive Board Member,* Wisconsin Quantum Computing Club**   **10/2023-now**
- Held the first "Advanced topics in quantum computation" seminar on adiabatic evolution, variational quantum eigensolver and their Qiskit realization.
- Assumed the role of Qiskit Fall Fest mentor, helped students to finish and improve their Qiskit Hackathon projects.

***Key Member,* Fudan University Bridge Club**   **09/2019-now**
- Taught and analyzed the bridge card examples for the case study
- Won the **championship of Shanghai Intellectual Games**; participated in other various bridge competitions, such as the annual College Students' Online Bridge Trials and the "Bridge Star" Youth Online Doubles Competition.

Live presentation speech on Koushare, invited by Huawei (https://m.koushare.com/lives/room/908923)   **07/2022**
The Second Place Winner, 2021 Quantum Computing Hackathon National Competition   **05/2021**
Qiskit Summer School 2020; 2021, 2022 Quantum Excellence Certificate; 2023   **07/2020, 07/2021, 07/2022, 07/2023**
The Recurrence Award Winner, 2021 Huawei Cloud Quantum Computation Paper Recurrence Competition   **08/2021**
Leading Guitarist, Fudan University Musicians Union   **09/2019-08/2020**

Interests & Skills

- Research Interests: Quantum computation, Quantum information, Quantum simulation, Quantum Many-body physics
- **IBM Certified Associate Developer - Quantum Computation using Qiskit v0.2X**
- Proficient in Python, C++, Matlab Scientific Computing and Machine Learning, TensorFlow, Cuda C++ Parallel Computing, PHP, Html, JavaScript web-development
- IELTS: 8 (R 8.5/L 9.0/ S 7.0/ W 7.0); GRE: 152+170+3.5
- Hobbies: Electric Guitar, Bridge, Riichi Mahjong